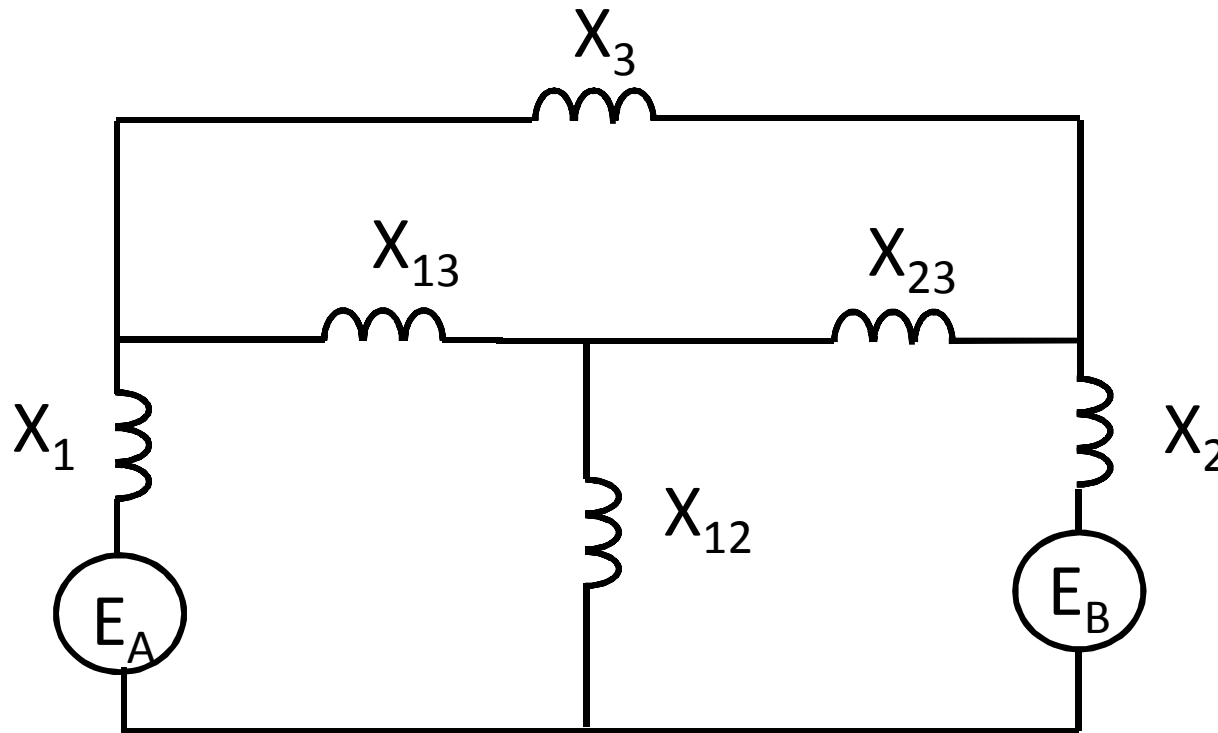


Network Equations and Solution

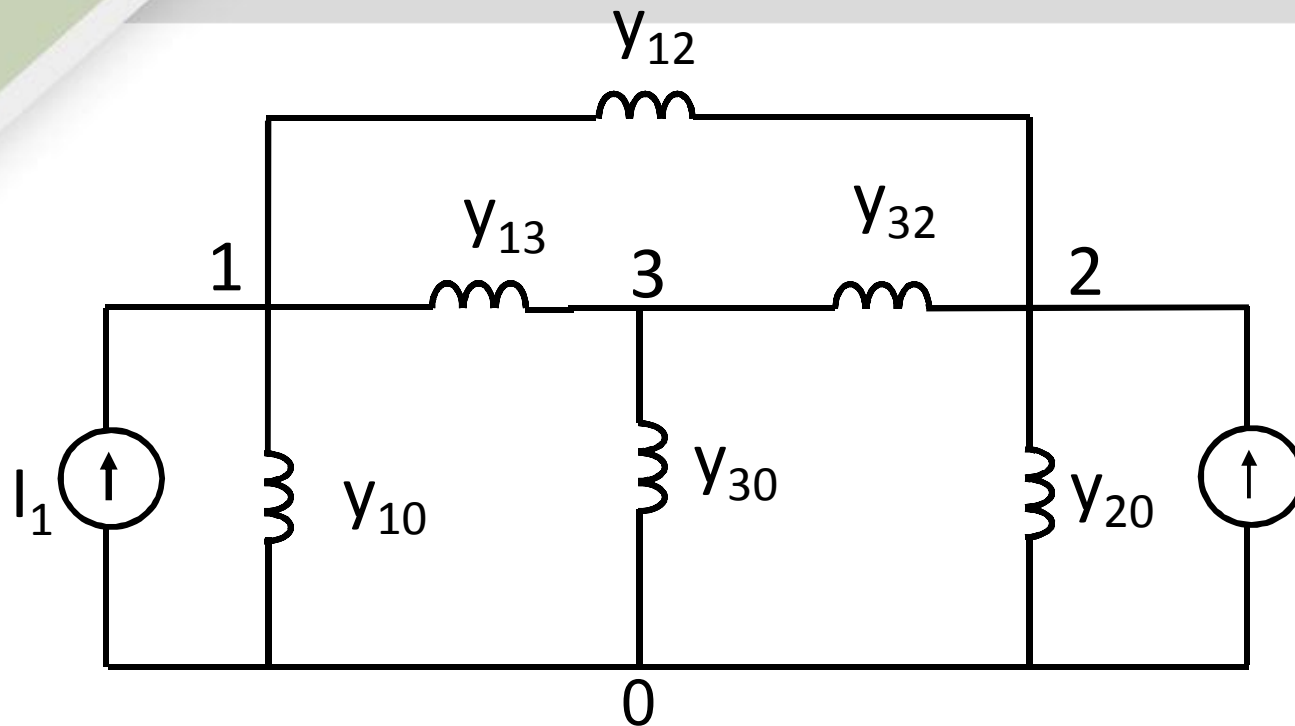
Node Equations

- Convert the impedance representation to the admittance representation
- Convert the voltage sources to current sources



Network Equations and Solution

Node Equations



Apply Kirchhoff's current law at each node

$$\sum I = 0$$

$$I_1 = y_{10}(V_1 - 0) + y_{12}(V_1 - V_2) + y_{13}(V_1 - V_3)$$

Network Equations and Solution

Node Equations

$$\begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} y_{11} & -y_{12} & -y_{13} \\ -y_{21} & y_{22} & -y_{23} \\ -y_{31} & -y_{32} & y_{33} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

$$\mathbf{I} = \mathbf{y}_{\text{Bus}} \mathbf{V}$$

$$\mathbf{V} = \mathbf{y}_{\text{Bus}}^{-1} \mathbf{I}$$

$$\mathbf{V} = \mathbf{Z}_{\text{Bus}} \mathbf{I}$$

Network Equations and Solution

Node Equations

Y_{Bus} is the admittance matrix:

- ▶ It is a square matrix
 - ▶ The main diagonal contains the self-admittance: the summation of all admittances connected to this node
 - ▶ The off diagonal contains the mutual admittances between the different nodes
 - ▶ The main diagonal contains admittances with positive signs, which means a negative value (the admittance itself has a negative value, i.e. $-j x$)
 - ▶ The elements in the off diagonal are admittances with negative signs, which means positive values.
-